FLUKE®

Biomedical

Electrical Safety Analyzer

ESA601

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- Getting Started Manual
- Manuel d'introduction
- Manuale dei prodotti
- Einleitungshandbuch
- Manual de funcionamiento básico
- スタート・マニュアル
- 入门手册

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FLUKE®

Biomedical

ESA601

Electrical Safety Analyzer

Getting Started Manual

November 2004

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Specifications subject to change without notice.

Warranty

Warranty and Product Support

Fluke Biomedical warrants this instrument against defects in materials and workmanship for one full year from the date of original purchase. During the warranty period, we will repair or, at our option, replace at no charge a product that proves to be defective, provided you return the product, shipping prepaid, to Fluke Biomedical. This warranty does not apply if the product has been damaged by accident or misuse or as the result of service or modification by other than Fluke Biomedical. IN NO EVENT SHALL FLUKE BIOMEDICAL BE LIABLE FOR CONSEQUENTIAL DAMAGES.

Only serialized products and their accessory items (those products and items bearing a distinct serial number tag) are covered under this one-year warranty. PHYSICAL DAMAGE CAUSED BY MISUSE OR PHYSICAL ABUSE IS NOT COVERED UNDER THE WARRANTY. Items such as cables and nonserialized modules are not covered under this warranty

Recalibration of instruments is not covered under the warranty.

This warranty gives you specific legal rights. You may also have other rights which vary from state to state, province to province, or country to country. This warranty is limited to repairing the instrument to Fluke Biomedical's specifications.

Warranty Disclaimer

Should you elect to have your instrument serviced and/or calibrated by someone other than Fluke Biomedical, please be advised that the original warranty covering your product becomes void when the tamper-resistant Quality Seal is removed or broken without proper factory authorization. We strongly recommend, therefore, that you send your instrument to Fluke Biomedical for factory service and calibration, especially during the original warranty period. (When returning the product for any reason, be sure to follow the "Return Procedure" in "Standard Terms and Conditions" in the section in the Operator's Manual called "Notices.")

In all cases, breaking the tamper-resistant Quality Seal should be avoided at all cost, as this seal is the key to your original instrument warranty. In the event that the seal must be broken to gain internal access to the instrument, you must first contact Fluke Biomedical's Technical Assistance Department at 775-883-3400. You will be required to provide the serial number for your instrument as well as a valid reason for breaking the Quality Seal. You should break this seal only after you have received factory authorization. Do not break the Quality Seal before you have contacted us. Following these steps will help ensure that you will retain the original warranty on your instrument without interruption.

Manufacturing Location

The ESA601 is manufactured in Everett, WA, USA.

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⚠⚠Warning. Read before using Analyzer.

To avoid possible electrical shock or personal injury, follow these guidelines:

- Do not use the ESA601 in any manner not specified in the Operator's Manual.
- Before connecting or disconnecting a DUT to the ESA601, the FUNCTION-SELECTION KNOB should be set to the OFF position.
- Exercise extreme caution when a shock hazard is present at the instrument's measurement terminals during the following tests:
  - Mains-Insulation test
  - Applied-Parts-Insulation test
  - Mains-on-Applied-Parts-Leakage-Current test
  - Equivalent-Device-Leakage-Current test
  - Equivalent-Patient-Leakage-Current test
- Always turn OFF power to the ESA601 and unplug the power cord before cleaning the outer surface.
- Portable devices located in isolated power systems should be tested on an earth-referenced power system. Either remove the DUT to an area with an earth-referenced power system, or use an extension cord to bring earth-referenced power to the DUT.
- Inspect the product, if the instrument appears damaged or appears to operate in a manner not specified in the manual, DO NOT CONTINUE USE. Return the product for service.
- Avoid spilling liquids on the analyzer; fluid seepage into internal components creates corrosion and a potential shock hazard. Do not operate the instrument if internal components are exposed to fluid.
- Do not open this product. There are no user replaceable parts.

Caution

The ESA601 should be calibrated annually. Only qualified technical personnel should perform troubleshooting and service procedures on the ESA601.

Do not expose the system to temperature extremes. Ambient operating temperatures should remain between 10 to 40 °C. System performance may be adversely affected if temperatures fluctuate above or below this range.

Clean only with a damp, lint-free cloth, using a mild detergent, and wipe down gently.

Before each use, inspect the test-lead ends for possible wear, cracks or breaks.

Take leakage-current measurements only after earth resistance is measured and found to be compliant with the applied safety limit.

If the DUT fails the Protective-Earth-Resistance test, the operator must discontinue testing and label the DUT defective.*

If any single test fails, the test must be discontinued immediately and the DUT labeled defective.*

*In order for the ESA601 Controller Software to comply with these statements, "Stop Autosequences On Failures" would need to be checked on the General tab, under the System Configure menu.

Getting Started Manual

Introduction

This Getting Started Guide provides basic information on Fluke Biomedical's ESA601™ Electrical Safety Analyzer (hereafter called the ESA601). Refer to the Operator's Manual (provided on the CD) for complete operating instructions.

Table 1 lists the eight available versions of the ESA601 Electrical Safety Analyzer.

Unpacking the ESA601

Using Table 2 as a reference, unpack the ESA601 and its accessories from the shipping carton. Check for missing parts and inspect the unit carefully for damage, such as cracks, dents or bent parts. If items are missing or any physical damage is apparent, please call Fluke Biomedical for assistance. For information on ways to contact Fluke Biomedical, see the section in this manual called "Support." Also, notify the carrier if the damage appears to be the result of a shipping mishap.

Table 1. ESA601 Electrical Safety Analyzer (8 versions)

Version	DUT Outlet (Test Receptacle)	Detachable Power Cord	Language Overlay	Model #
Australian	Australia/New Zealand AS/NZ 3112-1993	Australian	English 1	ESA601-AUS
ROW (international)	Schuko CEE7	European	English 1	ESA601-SHK
French	Schuko CEE7	European	French	ESA601-FRA
German	Schuko CEE7	European	German	ESA601-DEU
Italian	Schuko CEE7	European	Italian	ESA601-ITAL
United Kingdom	United Kingdom BS 1363A	British	English 1	ESA601-UK
United States	United States NEMA 5-15R	120 V / 15 A	English 1 (IEC Terms)	ESA601-USA/IEC
United States	United States NEMA 5-15R	120 V / 15A	English 2 (AAMI Terms)	ESA601-USA

Table 2. Accessories

Item	Part Number	Standard Accessory	Optional Accessory
RED test lead with probe	2391738	X	
BLACK test lead with probe	2391723	X	
ESA601 Operator's Manual & Controller Software CD	2388919	X	
Serial cable (Null Modem)	2238626	X	
ESA601 Getting Started	2243822	X	
Five alligator/banana plug adapters	2391714	X	
Soft-sided carrying case	2248650	X	
Country-specific power cord		X	

Table 2. Accessories (cont.)

Item	Part Number	Standard Accessory	Optional Accessory
DPU414 serial printer, 40 columns with choice of AC adapter	2248899		X
120-V AC adapter	2235375		
or 220-V AC adapter	2235382		
North American 220-V adapter kit	2185787		X
U.S. 220 V power cord	2238671		X
DPU414 serial printer cable	2238659		X
Alligator clamp	2004175		X
Banana/ECG adapters	2391669		X
ESA601 Service Manual	2243831		X

Storage and Maintenance

As with most electronic equipment, the ESA601 should be operated in a dry area within normal temperature limits (10 ℃ to 40 ℃). The maximum relative humidity at temperatures up to 31 ℃ is 80 %, decreasing linearly to 50 % relative humidity at 40 ℃.

There are no special storage requirements. However, when storing the unit, maintain the storage temperature between -25 ℃ and 50 ℃.

Although the power output from the ESA601 is not potentially dangerous, internal circuits carry potentially lethal voltages and currents. For safety reasons, maintenance requiring internal access should be performed only by an experienced technician.

Characteristics

The following two sections will help familiarize you with the ESA601 Electrical Safety Analyzer's controls and features.

Top and Side Panels

Table 3 lists and describes the controls (called out in Figure 1) located on the top and side panels of the ESA601. Some controls will have two names. The first name is the IEC nomenclature and the second, the AAMI nomenclature.

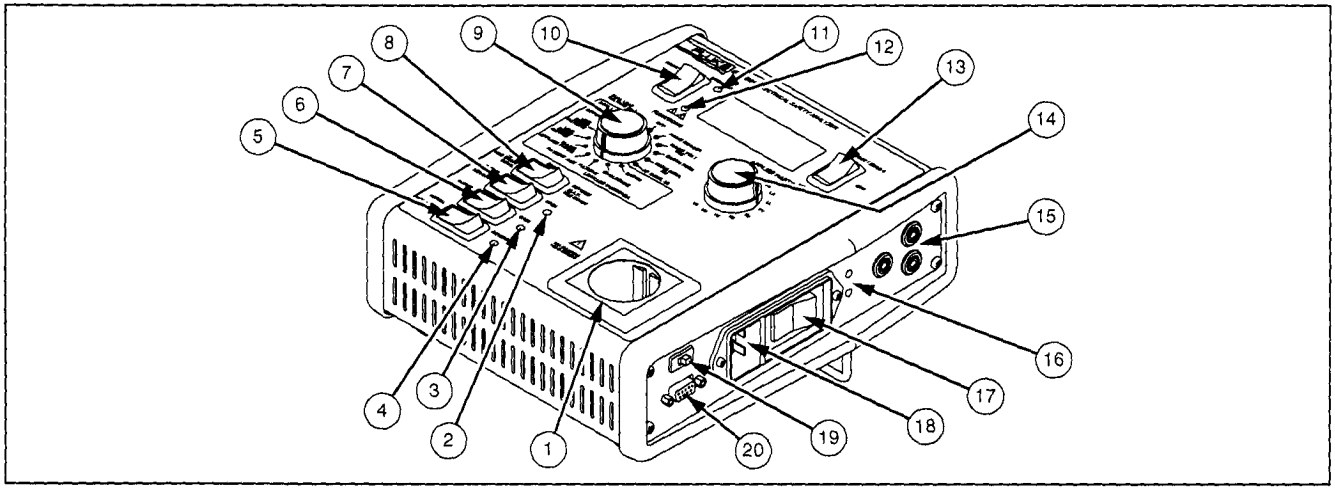

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Figure 1. Top and Side Panel Views of the ESA601

Table 3. Top and Side Panel Features

No.	Name	Description
1	TEST RECEPTACLE	An equipment outlet, specific to the version of the instrument, that provides a DUT connection: AS 3112-1993 (Australia); BS 1363A (English –United Kingdom); NEMA 5-15R (English –United St ates); Schuko CEE7 (French, German, Italian, and ROW [international]).
2	OPEN-NEUTRAL INDICATOR	An LED next to the NEUTRAL SWITCH, which illuminates with an amber light (OPEN) if Equipment L2 is OPEN.
3	OPEN-EARTH INDICATOR OR OPEN GROUND INDICATOR	An LED next to the EARTH (or GROUND) SWITCH, which illuminates with an amber light (OPEN) if Equipment Earth is OPEN.
4	REVERSE-STATUS INDICATOR (DUT POLARITY)	An LED next to the POLARITY SWITCH, which illuminates with an amber light (REVERSE) if the Equipment-Outlet polarity is reversed.
5	POLARITY SWITCH	A rocker switch (toggle) with two positions (NORMAL, REVERSE), which reverses the polarity of the Equipment Outlet voltage.
6	EARTH SWITCH OR GROUND	A rocker switch (toggle) with two positions (CLOSED, OPEN), which opens the connection between Mains Earth and Equipment Earth (GROUND).
7	NEUTRAL SWITCH	A rocker switch (toggle) with two positions (CLOSED, OPEN), which opens the L2 line on the Mains side of the Mains POLARITY SWITCH.

Table 3. Top and Side Panel Features (cont.)

No.	Name	Description
8	M.A.P./ VDE EQUIV INSUL SWITCH OR ISO VDE EQUIV INSUL SWITCH	A rocker switch with three positions (NORMAL, OFF, REVERSE). The NORMAL and REVERSE positions are momentary, while the natural resting position is OFF. When the MAINS APPLIED PARTS (or LEAD ISOLATION) leakage-current test function is selected, this switch permits NORMAL and REVERSE polarity of the isolated Mains voltage. When either the VDE: EQUIV PATIENT or VDE:EQUIV DEVICE function is selected, this switch permits NORMAL and REVERSE polarity of the isolated Mains voltage. When either the MAINS INSUL or AP INSUL (or LEADS INSUL) function is selected, this switch enables the insulation-test voltage if (and only if) the switch is held down in the NORMAL position.
9	FUNCTION-SELECTION KNOB	A rotary switch with unlimited rotation, which enables the selection of any of sixteen functions.
10	PRINT SWITCH	A rocker switch with a momentary activation in the upward position, which sends the current measurement value to an ASCII text printer through the tester's RS-232 serial port. Applies only to Local Mode.
11	OVER-RANGE-STATUS INDICATOR	An LED to the upper right of the PRINT SWITCH, which illuminates with a solid red light (OVER RANGE) if the input exceeds measurement range.

Table 3. Top and Side Panel Features (cont.)

No.	Name	Description
12	HIGH-VOLTS-STATUS INDICATOR	An LED to the lower right of the PRINT SWITCH, with caution symbols underneath, which illuminates with a flashing RED light (HIGH VOLTS) if M.A.P. voltage or 500 V DC is present on either the applied parts or L1/L2 on the equipment outlet.
13	OHMS-FUNCTION SWITCH	A rocker switch that is functional only while the FUNCTION-SELECTION KNOB is positioned at the EARTH RES Ω (or GROUND WIRE RES Ω) function. This switch utilizes three positions (OFFSET / ZERO 0, OFF, MEASURE Ω). The mutually exclusive OFFSET / ZERO 0 and MEASURE Ω positions are momentary, while the natural resting position is OFF. A one-amp supply is turned ON when the switch is depressed to either the OFFSET / ZERO 0 or MEASURE Ω position, and is turned OFF when the switch is released. Meter readings are saved on the display for printing (if desired) upon release of the switch. A null offset is generated when OFFSET / ZERO 0 is depressed and the meter reads < 0.150 ohms; OL displays if a null offset was not generated. The null value is stored until another null is done.
14	APPLIED-PARTS-SELECTION KNOB OR ECG-LEADS-SELECTION KNOB	A rotary switch with eleven usable positions, which enables the selection of any individual –or all ten –applied parts (or ECG Leads) connectors.

Table 3. Top and Side Panel Features (cont.)

No.	Name	Description
15	SIGNAL CONNECTIONS	Three safety-style banana jacks, which provide signal connections: RED –signal input connection fo r Dual-Lead-Voltage, Dual-Lead-Leakage, and Protective-Earth-Resistance (or Ground-Wire-Resistance) tests, and Leakage Currents; GREEN – direct connection to Equipment Outlet Earth; and BLACK –signal input connection for Dual-Lead-Voltage and Dual-Lead-Leakage tests.
16	POWER-STATUS INDICATORS	Two LEDs next to the POWER SWITCH. The lower LED illuminates with a green light (POWER) when the tester is switched on, while the upper LED illuminates with a RED light (POWER FAULT) if the inlet polarity is reversed, or there is a fatal error at power-up.
17	POWER SWITCH	A rocker switch (toggle) with two positions (ON, OFF), which controls operating power to the tester.
18	POWER (MAINS) INLET	Accepts a standard IEC 60320-1 / C19 Mains inlet rated at 16 A and 250 V for Class-1 equipment in cold conditions.
19	LOAD-SELECTION SWITCH	A slide switch, which permits the selection of either the ANSI / AAMI ES1 or the IEC 60601-1 patient load
20	RS-232 PORT	A serial interface, which, in Remote Mode, enables remote operation of the ESA601, and provides a download port for processor firmware. In Local Mode, this port can be used to output test results to a serial ASCII printer when the PRINT SWITCH is pressed.

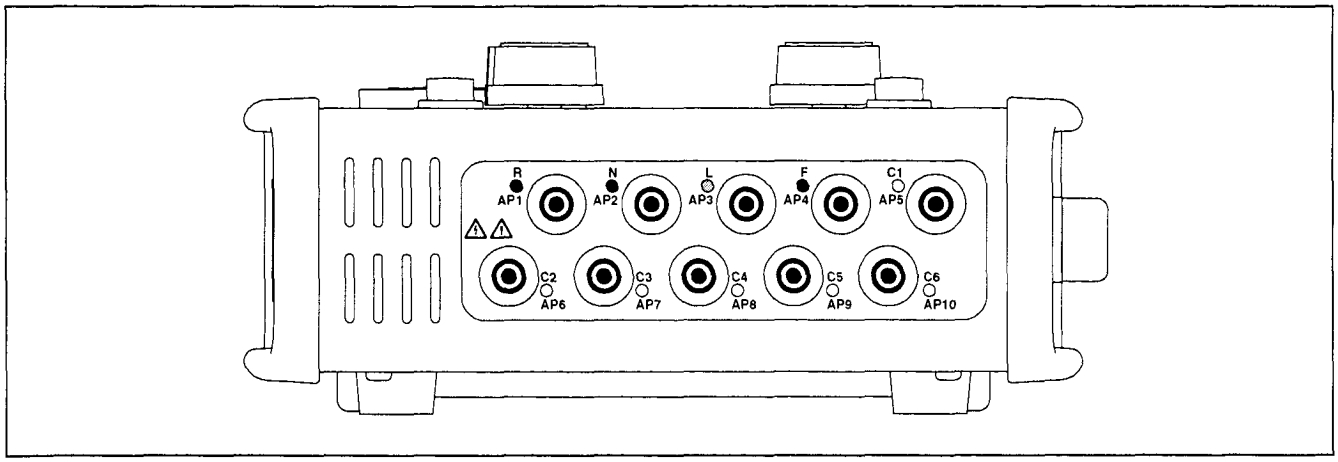

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Figure 2. Back Panel View of the ESA601 (IEC)

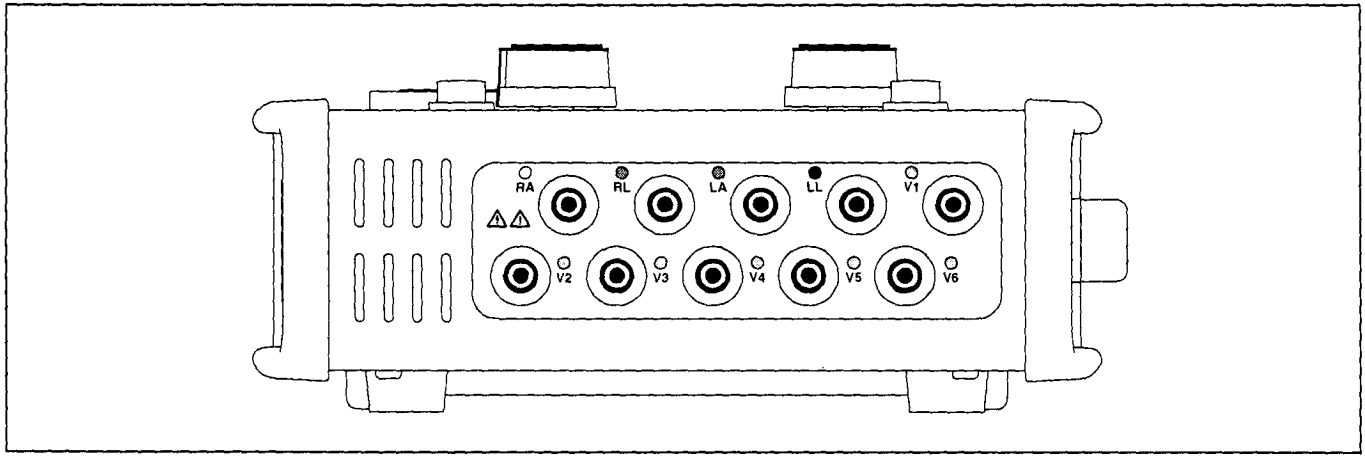

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Figure 3. Back Panel View of the ESA601 (AAMI)

Back Panel

The back panel of the ESA601 features a full set of universal ECG jacks for connecting applied parts. Figure 2 shows the IEC nomenclature and Figure 3, the AAMI nomenclature. AHA and IEC color-coded dots label the jacks as an aid to connecting the corresponding U.S. and international ECG leads. Table 4 identifies the use of each ECG jack.

Table 4. Back Panel Features

Label	Meaning
RA or R, AP1	Right arm, applied part 1
RL or N, AP2	Right leg, applied part 2
LA or L, AP3	Left arm, applied part 3
LL or F, AP4	Left leg, applied part 4
V_1, V_2, V_3, V_4, V_5, and V_6	V Leads (U.S. and Canada), also referred to as pericardial, precordial, or unipolar chest leads
C_1, C_2, C_3, C_4, C_5, and C_6	Chest leads (international)
AP5, AP6, AP7, AP8, AP9 and AP10	Applied parts 5 through 10

Powering Up

1. Turn the FUNCTION-SELECTION KNOB to the OFF position.
2. Power up the system by pressing the POWER SWITCH to the ON position. After three seconds the unit powers up, and a green light appears in the POWER LED to indicate the tester is switched on.
3. When the unit is powered up, the ESA601 will check for proper polarity and range of the AC-input voltage. During this check, the display indicates firmware version number X.XX (e.g., 1.00, etc.). If all goes well, the display should then show OFF.
4. If the FUNCTION-SELECTION KNOB is not set to OFF when the unit is powered up, the unit immediately moves (with audible clicking) to the mode indicated by the current FUNCTION-SELECTION KNOB setting, and the display indicates a reading related to that selected function (usually a meter reading). If a fault is found at startup, a RED light appears in the POWER FAULT LED, and the ESA601 display indicates an error code. (For explanations of startup-error codes, see the section in this manual called "Error Codes.")

Support

After power-up and connection, if the new ESA601 system fails to start or to operate successfully, please contact Fluke Biomedical immediately. The Technical Assistance Center is open between 8:00 AM and 5:00 PM, Pacific Standard Time, Monday through Friday, except holidays. When contacting the Technical Assistance Center, please provide the following information: ESA601 version and serial number; specific steps necessary to reproduce the problem; and a phone number where you can be contacted during the day.

Contact Fluke Biomedical in the following ways

Telephone:	(800) 648-7952 (in the U.S.A.) or (775) 883-3400
Mail:	Fluke Biomedical 5200 Convair Drive Carson City, NV 89706-0403
E-mail	techservices@flukebiomedical.com; sales@flukebiomedical.com

Selecting Language Options

Five language options support the eight available factory-set versions of the ESA601 that are unique combinations of types of DUT outlet (test receptacle), detachable line cord, and overlay language: English with IEC nomenclature ("E"), English with AAMI nomenclature

("E-US," default), French ("F"), Italian ("I"), and German ("D").

When the unit is initially received, the factory-set, default-language option should match the instrument's overlay language. However, if this is not the case, or if for any reason the current default language is not the one desired, perform the following steps to change the default:

1. To select a language other than the current default, hold down the OHMS-FUNCTION SWITCH in the MEASURE Ω position while powering up the ESA601.
2. When the display indicates "SEL," release the switch.
3. To cycle through optional language selections, repeatedly press and release the OHMS-FUNCTION SWITCH in the MEASURE Ω position.
4. When the code for the desired language option (i.e., E, F, I, or D) displays, wait for two seconds; the language selection indicated on the display is saved automatically.
5. The new default language remains in effect until steps #1 through #4 are repeated.

Note

Choosing a language option affects only the report printouts and the responses to the remote port; it does not affect the display.

Selecting the Printer Output

The printer used should support RTS/CTS or XON/XOFF protocols. Printer operation requires a straight-through serial printer cable.

For most ESA601 electrical-safety tests:

1. To print a top-level header in the language set as the current default, press the PRINT SWITCH with the FUNCTION-SELECTION KNOB set to the PRINT HEADER position.
2. To print the result of a function test (usually a meter reading), press the PRINT SWITCH in the upward position with the FUNCTION-SELECTION KNOB set to the desired function position. The ESA601 provides the meter reading, as well as the current status of related front-panel switches.

Note

If the PRINT SWITCH is pressed with the FUNCTION-SELECTION KNOB set to the OFF position, no printout results.

Connecting the Device Under Test

Figure 4 illustrates how to connect the ESA601 to a device under test.

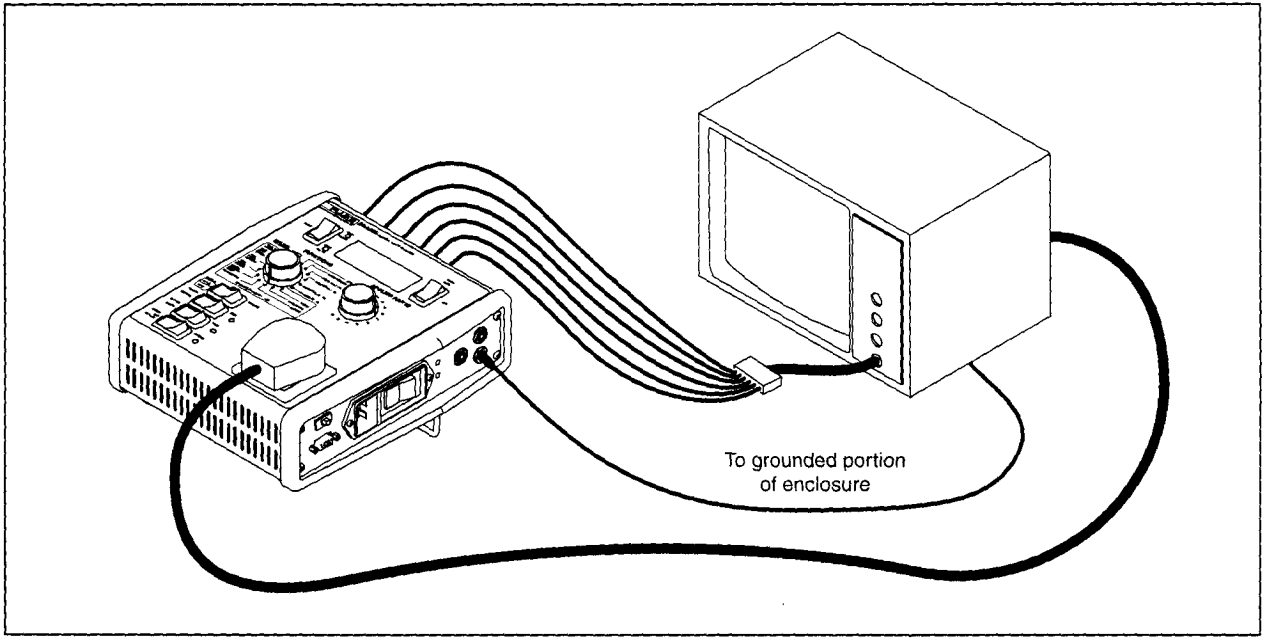

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Figure 4. The ESA601 Connected to a Device Under Test

⚠⚠Warning

To avoid the possibility of electric shock, the FUNCTION-SELECTION KNOB should be set to the OFF position whenever connecting or disconnecting a DUT to the ESA601.

1. Connect the DUT's applied parts to the universal ECG jacks on the back panel of the ESA601. (See Figure 3.) AHA and IEC color-coded dots label these jacks as an aid to connecting the corresponding U.S. and international ECG leads.
2. Connect the power cord from the DUT to the version-specific test receptacle on the ESA601.

Selecting the Test Load

A slide switch on the ESA601 permits the selection of either the ANSI / AAMI ES1 or the IEC 60601-1 measurement load (American or European standards, respectively). Select the test-load type before beginning testing.

Selecting the Operating Mode

Local Mode is the default setting upon powering up the ESA601. In Local Mode, functions are selected by manually positioning the FUNCTION-SELECTION KNOB. To change modes from Local to Remote, use a terminal-emulation program to send the remote command **REMOTE** (with no parameters) to the RS-232 serial port.

The system responds with the message "WAIT," followed by the message "REMOTE MODE OK."

Note

When the mode is changed from Local to Remote, the system initially sets the "active" function to OFF. (This action turns OFF all power to the Equipment Outlet and to applied parts, but not power to the ESA601.)

To change modes from Remote to Local, send the remote command **LOCAL** (with no parameters). The system responds with the message "LOCAL MODE."

Performing Electrical Safety Tests

For test-principle diagrams and step-by-step testing procedures for each of the following ESA601 electrical-safety tests, refer to the Operator's Manual provided on the CD-ROM (P/N 2388919).

- Mains Voltage or Mains Line
- Protective-Earth Resistance or Ground-Wire Resistance
- Mains-Insulation Resistance
- Applied-Parts-Insulation Resistance
- Earth-Leakage Current or Ground-Wire-Leakage Current
- Enclosure-Leakage Current or Chassis-Leakage Current

- Patient-Leakage Current or Lead-to-Ground-Leakage Current
- Patient-Auxiliary-Leakage Current or Lead-to-Lead-Leakage Current
- Mains-on-Applied-Parts-Leakage Current or Lead-Isolation-Leakage Current
- VDE: Equivalent-Device-Leakage Current
- VDE: Equivalent Patient-Leakage Current
- VDE: Differential-Leakage Current
- Dual-Lead-Leakage Current
- Dual-Lead Voltage

Error Codes

The ESA601 performs self-diagnostic tests during power-up and startup. If a problem is detected during these times, an error code will be displayed.

Power-Up Diagnostic Errors

A power-up error is indicated if the ESA601 has the POWER LED on, POWER FAULT LED on, blank display, and continuously outputs one of the error codes (listed in Table 5) to the serial transmit line. If any of the Power-Up Error Codes occur, contact your local Fluke service center to arrange repair of the ESA601.

Table 5. Power-Up Diagnostic Error Codes

Code	Description
0x01	Instruction Test Error
0x05	RAM Test Error
0x09	Flash-Checksum Error

Startup Diagnostic Errors

If a fault is found at startup, a red light appears in the POWER FAULT LED, and the ESA601 displays one of the following error codes:

Table 6. Startup Diagnostic Error Codes

Code	Description	User Action
Err0	EEPROM checksum error. - The unit probably needs calibration.	To continue, hold down the OHMS-FUNCTION SWITCH in the OFFSET / ZERO 0 position
Err1	Input AC is out of range. (Turns ON the POWER FAULT LED.) - The meter may be out of calibration.	To continue, hold down the OHMS-FUNCTION SWITCH in the OFFSET / ZERO 0 position.
Err2	Physical Earth to Neutral voltage is incorrect. (Turns ON the POWER FAULT LED.)	To continue, hold down the OHMS-FUNCTION SWITCH in the OFFSET / ZERO 0 position.
	This may mean: - AC Hot and Neutral are reversed. - There is a bad connection to Earth Ground. - The meter may need calibration.	
Err3	Error during SPI Bus Initialization. - This is a fatal error.	Contact Fluke Service Department.
Err4	Error in reading back SPI Bus data from the power control board. - This is a fatal error.	Contact Fluke Service Department.
Err5	Continuous input overload.	To reset this error, remove inputs to the ESA601 then power OFF and back ON.

Service

The ESA601 should be calibrated once a year by a qualified technician. It is recommended that the instrument be sent to a Fluke service center for calibration or service.

Specifications

General Specifications

Operating Voltage Range:	Mimimum 90 V AC Maximum 264 V AC
Line Cords and AC Mains Inlet:	16 A or greater, 250 V for Class-1 equipment in cold conditions.
Equipment Outlet:	15 A, 250 V for Class-1 equipment in cold conditions for Australian, European, and United States versions. Reduced to 13 A for the United Kingdom version.
Protection Circuitry:	Signal I/O connections (excluding the RS-232 port and earth connections) withstand a continuous input of 264 V AC, 47-63 Hz, or ± 264 V DC without causing permanent damage.
Size:	9.8 L x 3 D x 8.25 W (inches)
Weight:	≤5 pounds
Temperature:	Operating: 10 to 40 °C. Storage: -25 to 50 °C
Maximum Humidity:	80 % relative humidity up to 31 °C, decreasing linearly to 50 % relative humidity at 40 °C.

Performance Specifications

Leakage-Current Measurement

Ranging:	Auto
Configuration:	RMS current flowing through the IEC 60601-1 test load or AAMI test load (selectable).
Range:	0 – 8000 µA True-rms
Display Units:	µA
Display Resolution:	1 µA
Accuracy:	±1 % of reading ± 2 µA @ DC and 25 Hz to 1000 Hz†; ±2.5% of reading (±2 µA) 1kHz to 200 kHz*† Frequency response DC to 1 MHz (-3 dB)
Crest Factor:	<3
Input Impedance:	Per Figure 15 of IEC 601-1 1995

* Fullscale input

†The accuracy of Mains-On-Applied-Part leakage currents shall be ±2% of reading ±6uA.

Voltage Measurement

Ranging:	Auto
Range (Mains Voltage):	90 to 264 V True-rms
Range (Accessible Voltage):	0 to 264 V True-rms
Display Units:	V
Display Resolution:	1 V
Accuracy:	± 2 % of reading, ± 2 V
Crest Factor:	<3
Frequency Response:	DC to 1000 Hz -3 dB point
DC Input Impedance:	1 MΩ

Earth-Resistance Measurement

Ranging:	Auto
Display Units:	Ω
Range:	0 to 1.999 Ω
Display Resolution:	0.001 Ω
Accuracy:	± 2 % of reading, ± 5 MΩ
Current Source Amplitude:	1 A DC (± 10 %)

Insulation Measurement

Auto Ranging:	Yes
Display Units:	MΩ
Range:	0.5 MΩ to 100 MΩ
Display Resolution:	0.1 MΩ
Accuracy:	0.5 MΩ to 20 MΩ, ± 2 % of reading ± 200 kΩ; above 20 MΩ, ± 5 % of reading ± 200 kΩ
Voltage Source Amplitude:	500 V DC (± 10 %)

VDE Differential Current

Ranging:	Auto
Display Units:	μA
Range:	10 μA to 10000 μA
Display Resolution:	10 μA
Accuracy:	± 2 % of full scale

Mains on Applied Parts

Voltage: ≥ 110 % of input Mains voltage (at no load)

Phase: In-phase or 180 ° out-of-phase with Mains voltage

Input/Output-Connection Specifications

Mains Inlet: Standard IEC 60320-1 / C20 Mains inlet rated at 16 A and 250 V for Class-1 equipment in cold conditions

Equipment Outlet (Test Receptacle): Specific to version of instrument:
AS 3112-1993 (Australia)
BS 1363A (English – United Kingdom)
NEMA 5-15R (English – United States)
Schuko CEE7 (French, German, Italian, and ROW [international])

Signal Connections: Three safety-style banana jacks:
RED – signal input / output connection
GREEN – direct connection to Equipment Outlet Earth
BLACK – signal input / output connection for Dual-Lead-Voltage and Dual-Lead-Leakage tests

Applied-Part Connections: Ten banana jacks that enable the connection of applied-parts (ECG) leads to the meter circuit: right arm, right leg, left arm, and left leg, plus 6 chest leads

RS-232 Serial Port: A serial interface that, in Remote Mode, enables remote operation of the ESA601, and provides a download port for processor firmware. In Local Mode, this port can be used to output test results to a serial ASCII printer when the PRINT SWITCH is pressed.

Computer-Setup Specifications

Serial Cable:	Null modem is required
Port:	Bidirectional (Data Communications Equipment) RS-232
Baud Rate:	9600
Parity:	None
Start Bits:	1
Stop Bits:	1
Parity Bits:	8